

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

| | | | |
|--|--|---|--|
| (51) International Patent Classification ⁵ : H04R 1/08, 1/10, H04M 1/05 | | A1 | (11) International Publication Number: WO 90/10361 (43) International Publication Date: 7 September 1990 (07.09.90) |
| <p>(21) International Application Number: PCT/SE90/00121</p> <p>(22) International Filing Date: 22 February 1990 (22.02.90)</p> <p>(30) Priority data: 8900711-6 28 February 1989 (28.02.89) SE 8902098-6 12 June 1989 (12.06.89) SE</p> <p>(71)(72) Applicant and Inventor: ULLMAN, Johan [SE/SE]; Jöhannebergsgatan 32B, S-412 55 Göteborg (SE).</p> <p>(74) Agents: GRAUDUMS, Valdis et al.; Albihn West AB, Box 142, S-401 22 Göteborg (SE).</p> | | <p>(81) Designated States: AT (European patent), BE (European patent), CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FI, FR (European patent), GB (European patent), IT (European patent), LU (European patent), NL (European patent), NO, SE (European patent), US.</p> <p>Published <i>With international search report. In English translation (filed in Swedish).</i></p> | |
| <p>(54) Title: HEADSET</p> <p>(57) Abstract</p> <p>Headset arrangement comprising a securing member (1), which is designed to support an earpiece (2) and a microphone (3) and which is arranged on a wearer's head. The securing member (1) has at its one end an ear loop (4), which is designed to extend over the wearer's ear and to bear against the cranium behind the ear. At the other end, the member has a nose arch (5), which is designed to bear against the ridge of the wearer's nose and to extend with a connection part (7) to an intermediate part (6) which joins the ear loop and the connection part of the nose arch. At its front section facing towards the nose arch, the intermediate part bears against the jugal bone of the wearer.</p> | | | |

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

| | | |
|---------------------------------|---|-----------------------------|
| AT Austria | ES Spain | MG Madagascar |
| AU Australia | FI Finland | ML Mali |
| BB Barbados | FR France | MR Mauritania |
| BE Belgium | GA Gabon | MW Malawi |
| BF Burkina Faso | GB United Kingdom | NL Netherlands |
| BG Bulgaria | HU Hungary | NO Norway |
| BJ Benin | IT Italy | RO Romania |
| BR Brazil | JP Japan | SD Sudan |
| CA Canada | KP Democratic People's Republic of Korea | SE Sweden |
| CF Central African Republic | KR Republic of Korea | SN Senegal |
| CG Congo | LJ Liechtenstein | SU Soviet Union |
| CH Switzerland | LK Sri Lanka | TD Chad |
| CM Cameroon | LUX Luxembourg | TG Togo |
| DE Germany, Federal Republic of | MC Monaco | US United States of America |
| DK Denmark | | |

- 1 -

Title:

Headset

5 Technical field:

The present invention relates to a headset consisting of a microphone and one or two earpieces and a loop or other holding arrangement which holds the headset securely on the user's head in such a way that the microphone is placed in the vicinity of the mouth and the earpiece or earpieces is/are arranged on the one ear or on both ears.

10 For someone who spends a large part of his or her working day telephoning, a conventional telephone receiver, which it is often necessary to hold against the shoulder when two hands are needed, for example to leaf through papers, is very uncomfortable. Loud-speaker telephones give unsatisfactory sound quality, and for this reason they are seldom used for anything more than connections and conference calls.

15 20 When telephoning in cars, the noise of the car constitutes additionally a disturbance factor in so-called hands-free operation. Holding the receiver in the hand is unsuitable, and in some situations even dangerous, and holding it against the shoulder is even more dangerous or in many cases quite impossible. These disadvantages are eliminated with a headset supported on the head during use.

Prior art:

25 30 A headset is previously known from US Patent Specification 4,020,297 (Brodie) and US Patent Specification 4,179,590 (Snow). However, headsets of the type described in the said specifications and other similar arrangements have not gained more general application,

- 2 -

but have essentially come to be used by employees whose main task it is to answer telephone calls and handle telecommunications, for example exchange telephonists and flight controllers.

5 Technical problem:

This limited application is probably due to the fact that the headsets available today are associated with a number of drawbacks which are each sufficiently troublesome.

- 10 1. Two hands are needed to put them on and take them off.
2. They press against the ears, which causes discomfort.
3. They give one a feeling of being shut off, since normal stereophonic reception of surrounding sound is prevented.
4. They disturb the hair.
5. They are bulky.
6. Their appearance creates a psychological resistance to using them.
- 20 7. Those which are used for telephones are in addition often easily damaged.

Previously known arrangements for applying telephone receivers on the head or body have not functioned because the telephone receivers are heavy and the systems are clumsy and do not afford the freedom of movement which is necessary in order to maintain a normal pattern of movement despite the fact that one is telephoning or otherwise communicating by wire or radio.

25 Solution:

30 The invention is an arrangement which, like half a spectacle frame, bears on one ear and on the nose immediately below where a pair of spectacles may bear, and in addition against the area of the cheek-bone/jugal bone arch (zygomatic area). The loop which turns down behind the ear here comes to bear against the cranium

- 3 -

(mastoid process) which results in the arrangement sitting in a very stable manner and not moving in relation to the head even when the latter is moved very sharply.

5 **Advantages:**

The headset according to the invention

- can be taken off and put on easily with one hand;
- does not press against the ears;
- does not make one feel shut off or lose stereophonic reception;
- does not disturb the hair;
- is not bulky and weighs very little;
- does not create any psychological resistance due to its appearance;
- can also be used by those who wear spectacles;
- can be integrated in a pair of spectacle frames;
- remains in place even when the user moves;
- can be used outdoors even during very physical activity, for example sailing and skiing;
- can be shaped by anyone, without instruction, in order to fit the face;
- can function with very small power supplies by virtue of the fact that it can be designed with directional effect on the receiver; and,
- 25 - by virtue of the lack of movable parts, it is durable and inexpensive to produce.

Description of Figures:

The attached drawings show three embodiments of the invention.

- 30 Fig. 1 shows the basic design of the arrangement, when placed on a wearer's head.
- Fig. 2 shows a slightly different design and
- Fig. 3 shows another design, seen on its own.

Preferred embodiments:

- 35 According to Fig. 1 the arrangement comprises three main units: a securing member 1, an earpiece 2 and a

- 4 -

microphone 3. The securing member in turn has an ear loop 4, which is designed to be arranged in such a way that it extends over the top side of the wearer's ear and down the rear side thereof so as to bear against the skin over the cranium (mastoid process), a nose arch 5 which is designed to be arranged over the ridge of the nose, an essentially straight intermediate part 6 whose one end connects with the ear loop 4 and whose other, front end connects with the nose arch 5 via a connection part 7, which extends at an angle from the intermediate part 6. The intermediate part 6 is intended to bear via its front part against the skin in the area of the cheek-bone and the jugal bone arch (zygomatic area = maxilla and zygomatic arch), where the skin does not move when one is articulating.

The earpiece 2 diverges from the intermediate part 6 in front of the ear loop 4. The positioning of its sound-emitting, active part establishes the design of the earpiece. The arrangement is primarily intended to be used by people who are also occupied with tasks other than answering and speaking on the telephone; for example, conducting direct conversations with somebody else or driving a vehicle. For this reason it is preferable for it to be designed in such a way that the wearer is not in any way shut off from the environment. This means that the earpiece is preferably situated at a slight distance from the mouth of the auditory meatus, so that sound can also be picked up directly from the environment. In this respect the earpiece can be designed as a miniature loud-speaker and one with a strong directional effect. Figs. 2 and 3 in particular show the shape of an exponential horn. However, this preferred embodiment does not rule out the possibility of the arrangement being designed with an earpiece directly adjoining the ear or with a so-called shell which can be introduced into the auditory meatus.

The microphone 3, which diverges from the area where the

- 5 -

intermediate part 6 and the connection part 7 meet, extends forwards to a position at the side of the mouth, but preferably outside the current of air, which is generated when speaking. The microphone advantageously has a directional effect too. With a directional microphone, the distance to the mouth can be increased to such an extent that it can be used as a distance microphone in duplex telephony. The sound quality can be substantially increased in such telephony and in loud-speaker telephony with highly directional microphones, which do not pick up and transmit echo noise, but only the original sound, for example interference microphones.

The position of the microphone in relation to the mouth can be determined by its positioning on the securing member 1. The more direct connection to the securing member 1, as is shown in the figures, can be replaced by a suspension on an arm, which extends out from the front part of the intermediate part 6 or alternatively from the outermost part of the nose arch 5 and to the opposite side of the mouth in relation to the side where it is shown here.

The two other embodiments in Figs. 2 and 3 show the same main parts, and the reference designations 1-7 are also used in these figures. The various embodiments differ essentially in the arrangement of the earpiece and microphone on the securing member.

In general, the securing member 1 is flexible but dimensionally stable, so that it can easily be bent to the optimum shape even in the case of very considerable individual differences in head shape and size. This can be achieved, for example, by virtue of the fact that it contains a metal wire which can be shaped, or by virtue of the fact that it is made of a polymer which can be shaped when it is warm but becomes dimensionally stable at room temperature. Other possible solutions are thermoplastics which are flexible until they are heated.

With these, it should therefore be possible to set the desired shape by means of baking. The combination of flexibility and dimensional stability can also be achieved by providing it with one or more joints, by means of which it is possible to adjust the angle and position.

One possible design form is based on the principle that a metal wire is baked into a sleeve of plastic or other elastomer. The plastic sleeve is flexible like the metal wire, but because it is of varying thickness its stabilizing capacity is different at different points. This provides for the effect that when the arrangement is shaped in order to fit different faces, it bends firstly and with less resistance at certain points where the sleeve or the wire is thinner.

Because the plastic sleeve in addition does not have a round, but instead an oval or rectangular cross-sectional surface, torsions can be created, and these are found preferably in those parts where the plastic sleeve or the wire is thinnest.

By producing the arrangement in such a way that from the start it is bent in only two planes, but straight in the third plane, it is possible to choose whether it will be bent for use on the right side or left side. The securing member 1 according to Fig. 2 can easily be arranged in a supply position for bending according to the wishes of the wearer.

In the embodiment according to Figs. 2 and 3, the arrangement holds the earpiece 2 very close to the opening of the auditory meatus, without it being in contact with the skin. Sound can be directed towards the opening of the auditory meatus, for example by means of a small funnel 8 or an exponential horn or other acoustic principle increasing acoustic directivity. Moreover, such an arrangement can be constructed in such a way that it

is possible to adjust its position in relation to the attachment and in this way to vary the distance, and also the position, from the funnel opening to the auditory meatus opening. This is achieved by means of the fact
5 that the earpiece in the embodiment according to Figs. 2 and 3 is supported by an attachment 9 which is displaceable on the intermediate part 6 of the securing member 1. This attachment is designed as a casing which contains the functional parts of the earpiece, that is to say the equipment which is required for converting the supplied electrical or optical signals to sound, which can be emitted through the funnel or horn 8. This variation of the distance can be used as a sound volume control. It is
10 also possible to carry out turning. This function can also be used for altering the direction of the sound when adapting the arrangement for use on the right or left ear.
15

The movement of the earpiece in relation to the ear can be used, if it can be easily carried out, for adapting the strength of the sound arriving at the ear. In this way it can be used for achieving just the right balance between pick-up of sound from the environment and from the earpiece. This is essentially achieved either by altering the distance between the ear and the ear piece
20 and/or by turning the latter in different directions.
25

The microphone 3 as shown in Fig. 2 also has an attachment 10 which can also be displaceable on the intermediate part 6 for adapting the position of the inlet opening of the microphone.

30 In Fig. 3 the microphone is shown as diverging from a round capsule 11, with which the intermediate part 6 and the connection part 7 of the securing member 1 connects. The position of the microphone is adapted here by bending the said parts 6 and 7. In addition to being an attachment for the microphone 3, the capsule 11 can be designed
35 as a pivot bearing between the parts 6 and 7. If this

5 pivot bearing is designed as a friction joint, the angle between the parts 6 and 7 can be set for adapting the position between the ear loop 4 and the nose arch 5 to the individual head shape. This movement possibility can
10 be extended so far that the parts 6 and 7 can be folded in line with each other. In this way the entire headset, at the end which is situated adjacent to the capsule 11, essentially has the shape of an approximately straight rod. This is then able to be pushed down into a narrow
15 container or, for example, into the breast pocket, when the arrangement is not being used. Thus, for storage purposes, the more spread-out design shown in Figs. 1 and 2 is avoided. It is not necessary for the capsule 11 to perform the two functions of pivot bearing and holder for the microphone. The pivot bearing function can also be connected to a microphone design, for example according to Fig. 3, with a separate attachment 10 on the intermediate part 6.

20 The design according to Fig. 3 can also be easily arranged for quick change-over between wearing on the right-hand or left-hand half of the face. The nose arch, which in Fig. 3 is a separate member secured on the wire-like connection part 7, can easily be made pivotable in relation to the part 7. Pivoting 180° provides for change-over between the left and right positions. The microphone 3 can also be made pivotable in the capsule 11, and the earpiece 2 can likewise be pivoted by turning the attachment 9 on the intermediate part 6.

25

30 As emerges, the main task of the arrangement is to emit, as sound signals, signals which have been received via cables as electrical or optical signals or by wireless transmission. The latter can be effected by radio signals which are picked up by a receiver in the arrangement via an aerial. The aerial can either be integrated in the securing member 1 or consist of a wire aerial diverging from the arrangement. It is also possible to transmit the signals in a wireless manner via infrared light. The
35

- 9 -

other main task of the arrangement is to receive sound signals from the wearer, when the latter speaks, and to transfer them to a telephone network. This can be achieved in a manner corresponding to the reception of signals, in other words via cables or by means of wireless transmission.

One possible embodiment is provided with electronic level control of the sound intensity in one or both directions, that is to say power of the earpiece and sensitivity of the microphone.

With modern electronics, the whole arrangement can weigh considerably less than a pair of spectacles weighs. It is also possible to integrate the arrangement in a pair of spectacle frames.

The line for connection to the telephone network or other communications equipment can be connected either behind or in front of the ear.

It can be connected, via special contact devices with or without circuit switches, to modern telephones including mobile telephones and portable telephones.

It is possible, by using electronic circuits, to cause it to be connected only when one begins to speak. It can also be provided with a manually controlled switch for switching on and off. Such a switch can be positioned on the arrangement itself. It can also be placed in connection with telephone apparatuses or on the instrument panel of a car and is designed as a holder for the arrangement so the latter is activated when it is removed from its holder.

The arrangement can be provided with a mechanical contact breaker which ensures that it activates/opens the telephone when set down. For example, the contact devices can be incorporated in the nose support so that when these

are pressed apart or short-circuited, the telephone opens in the same way as when a conventional receiver is lifted from its rest position on the contact breaker buttons. This function can be present in parallel with or instead of a traditional receiver.

5 In the embodiment according to Fig. 3 with the capsule 11 designed as a pivot bearing, a circuit-breaking function can be present in the capsule, so that when the parts 6 and 7 are turned in line with each other, in other words

10 to the storage position, disconnection of the arrangement takes place.

15 The circuit breakers described above can also be coupled in such a way that a loud-speaker telephone or a mobile telephone fitted in a vehicle with hands-free functioning chooses to disconnect the loud-speaker/distance microphone function and instead connects the arrangement when the latter is activated.

20 Provided with electronic circuits for so-called VAD (voice administered dialling), the invention affords possibilities for telephoning without using the hands.

25 In case it is desired to position the earpiece and the microphone very close to each other and conduct the sound in tubes to the microphone and for loudspeakers, it may be expedient to provide the arrangement with a so-called semi-duplex automatic system for preventing circulation.

30 An additional member, which can be supported by the securing member, is a light indicator, for example in the form of a light diode. It can be arranged, for example, on any of the casings 9 or 11 in Fig. 3 for the electronic equipment. This light indicator is designed to light when a telephone conversation is in progress. It is particularly advantageous for it to be connected to the electronics in such a way that when a sound signal enters the arrangement and is sent out again through the

- 11 -

earpiece, the light indicator is lit as soon as a certain signal strength is exceeded. In this way anyone speaking to the person wearing the arrangement in question can see whether a conversation is actually in progress. If the 5 light indicator was to be lit the entire time a connection was established, this would mean that a conversation was actually in progress during those periods, which often occur during telephone conversations, when one is waiting for information, a further connection or the like. By allowing the light diode to light only when a 10 signal is coming in, anyone who wishes to contact the person who is telephoning will know when this is possible. Of course, it is also possible to allow the light diode in such a case to light upon an out-going 15 signal. However, it is possible to establish directly, without any such indication, if the person wearing the arrangement is himself speaking.

These arrangements of an electrical and electronic nature 20 are previously known from other contexts and this prior art can therefore be used by those skilled in the art. No more detailed description of such an arrangement is therefore given here, since sufficient information for implementation of the invention can be taken from the prior art.

An important problem with an arrangement of this type, 25 which is designed to permit alternating telephoning and other business, including direct conversations with other people, is to make the securing member so flexible that the advantages outlined in the introduction are achieved. This is achieved by means of the arrangement using a 30 suspension with three support points: namely the support by means of the ear loop 4 and its bearing against the skin over the cranium at its down-turning part, the support against the nose ridge via the nose arch 5 and, between these, the support of the intermediate part 6 35 against the skin over the cheek-bone/jugal bone.

The centre of gravity of the system is on or near the line between the two outermost support points. In the arrangements shown, the equipment which is arranged on the securing member is situated in such a way that the 5 centre of gravity of the system is also on the outside of the securing member. In this way a torsional force is achieved, which seeks to press the outermost part of the ear loop 4 in towards the cranium and the intermediate part against the cheek-bone/jugal bone area. The arrangement sits in a completely stable manner, and for this 10 reason one is barely aware of wearing it. Moreover, the arrangement can be put on and taken off using one hand only, which makes it just as simple to use as a traditional telephone receiver even for short calls. In 15 theory, the support point on the nose can be regarded as several support points, since it can be designed as two parts which bear on either side of the mid-line. Furthermore, as has been mentioned, part of the arrangement can be allowed to bear against the skin in 20 the area mentioned (zygomatic area) without inconvenience, since the skin here does not move when one is articulating. This provides for increased stability with lower pressure between the arrangement and the skin in each area of contact.

25 If the arrangement is designed for change-over between wearing on the right-hand and alternately left-hand side of the face and, as has been mentioned, it is desired that the centre of gravity should lie on the outside, that is to say in the position opposite the nose arch, 30 the position of the centre of gravity must be changed in relation to the intermediate part 6 upon change-over of the arrangement between the right-hand and left-hand position. This is achieved most simply by allowing the centre of gravity, as shown in the embodiment according 35 to Fig. 2 or 3, to be determined by the position of the part 9. This part is turned upon change-over and in this way an automatic change-over of the position of the centre of gravity is obtained.

By a combination of its low weight and the relatively strong forces seeking to hold the arrangement in its intended place, it sits firmly even upon sharp movements of the head. The forces of inertia are unable to overcome the forces seeking to maintain the intended position on the face. The fact that the latter forces are so comparatively strong can be explained, on the one hand, by the fact that that part 4 of the loop surrounding the upper/rear periphery of the part of the outer ear nearest the skull is curved and lies in a likewise curved notch, as a result of which it is fixed in all three planes, and on the other hand by the fact that those parts 4 which bear against the nose can be made to press, on the one hand, in the direction towards the ear and, on the other hand, towards each other. In this way it is entirely possible to make the arrangement such that it remains in its intended position completely or partially, regardless of the force of gravity and normal forces of inertia.

In situations where more violent movements of the body occur, the arrangement can be equipped with a second ear loop for particularly firm holding.

A typical area of use for the arrangement would be in a reception, for example a hotel reception. The receptionist there has the general task of answering frequent in-coming calls and at the same time attending to people on the premises, dealing with direct requests etc. If the arrangement is designed in the preferred manner, namely the earpiece is situated at a distance from the ear and the microphone does not lie in front of the mouth and at the same time the arrangement has a very discreet appearance with the securing member designed like a wire, the receptionist can carry out both the said tasks without direct conversations being disturbed by the fact that the arrangement is in position the whole time and ready for answering telephone calls or making telephone calls. In addition, the said light diode indicates when the receptionist can conduct direct conversations

without being prevented by telephone conversations. As a result of the simple design of the arrangement with the securing member designed in a flexible manner, the arrangement can be adapted easily to individuals replacing each other in reception.

If the telephone conversations are less frequent, it is possible to lay the arrangement aside and then, if required, easily put it on with one hand. The design is particularly advantageous if the arrangement is used for wireless communication, so that tasks requiring movement can also be carried out.

Within the scope of the following patent claims the arrangement can also be designed in other ways and can be adapted to the intended area of application and to the current techniques in telephone communication.

Patent Claims

1. Headset arrangement comprising a securing member (1), which is designed to support an earpiece (2) and a microphone (3) and is designed to be arranged on a wearer's head, so that the earpiece is arranged at the wearer's ear and the microphone at the wearer's mouth, characterized in that the securing member (1) has at its one end an ear loop (4), which is designed to extend over the wearer's ear and down the rear side thereof and to bear against the skin over the cranium behind the ear, and at the other end has a nose arch (5), which is designed to bear with an outer part against the ridge of the wearer's nose and to extend with a connection part (7) to an intermediate part (6) of the securing member, which intermediate part joins the ear loop and the connection part of the nose arch, and which intermediate part is designed at its front section facing towards the nose arch to bear against the skin over the zygomatic area (cheek-bone/jugal bone) on the wearer, so that the securing member is supported bearing against the wearer's skin at three points: at the ear, on the nose ridge and in the said area.
2. Arrangement according to patent claim 1, characterized in that the parts of the arrangement are positioned in such a way in relation to a main plane through the intermediate part (6), which will bear against the said skin area of the wearer, that the centre of gravity of the arrangement is located in this plane or on the side opposite this in relation to the position of the nose arch (5), when the arrangement is brought into the use state.
3. Arrangement according to patent claim 1 or 2, characterized in that the securing member (1) in its main

part consists of a wire-like element which forms the said intermediate part (6) and which at one end merges into the said ear loop (4), and whose other end merges into the said connection part (7) to the nose arch (5).

5 4. Arrangement according to patent claim 3, characterized in that the wire-like securing member (1) is designed so as to be able to be bent repeatedly with finger force for adapting to the wearer's head.

10 5. Arrangement according to patent claim 4, characterized in that the securing member (1) is provided with weak points, which facilitate bending at the intended sites.

15 6. Arrangement according to patent claim 5, characterized in that the securing member (1) consists of a soft, flexible metal body surrounded by a sleeve of a soft elastomer.

20 7. Arrangement according to any one of the preceding patent claims, characterized in that the intermediate part (6) and the connection part (7) are connected by an element (11) designed as a pivot bearing, so that the angle between the said parts (6, 7) can be altered, on the one hand for adapting the arrangement to individual head shapes, and on the other hand for folding the parts in line with each other for storage of the arrangement.

25 8. Arrangement according to any one of the preceding patent claims, characterized in that the earpiece (2) has the shape of a directivity-increasing arrangement, such as a funnel or a horn, for example an exponential horn, which is directed with its sound-emitting mouth towards the auditory meatus, but is situated at a distance from the latter.

30 9. Arrangement according to patent claim 8, characterized in that the earpiece (2) diverges from an

attachment (9), which is arranged on the intermediate part (6) of the securing member (1) and can be displaced in relation to the latter for adapting the position of the earpiece in relation to the wearer's ear by displacement and/or turning.

5

10. Arrangement according to any one of the preceding patent claims, characterized in that the microphone (3) is arranged with its receiver opening close to the wearer's mouth, but to the side of the latter so that it is not affected by the expiration air current, and has a directional effect for essentially picking up the conversation, with limited effect of other sound.

15. Arrangement according to any one of the preceding patent claims, characterized in that it is provided with a light indicator which, by means of connection to members which are active upon functioning of the arrangement during telephone connection, is designed to indicate when a telephone conversation is in progress.

20. Arrangement according to patent claim 11, characterized in that the light indicator is designed to activate indication during periods when signals are present in the said arrangement, but to keep the indication passive during a telephone connection during periods when no signal activity is present.

1/2

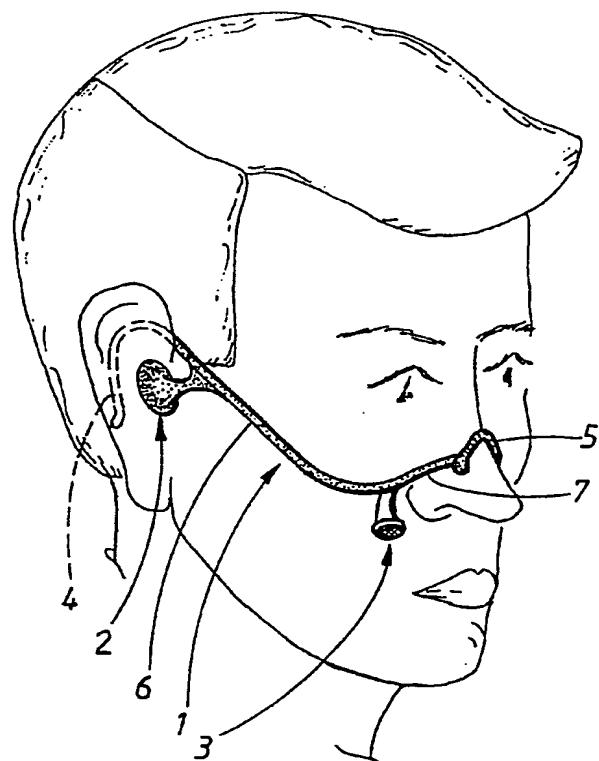


FIG. 1

2/2

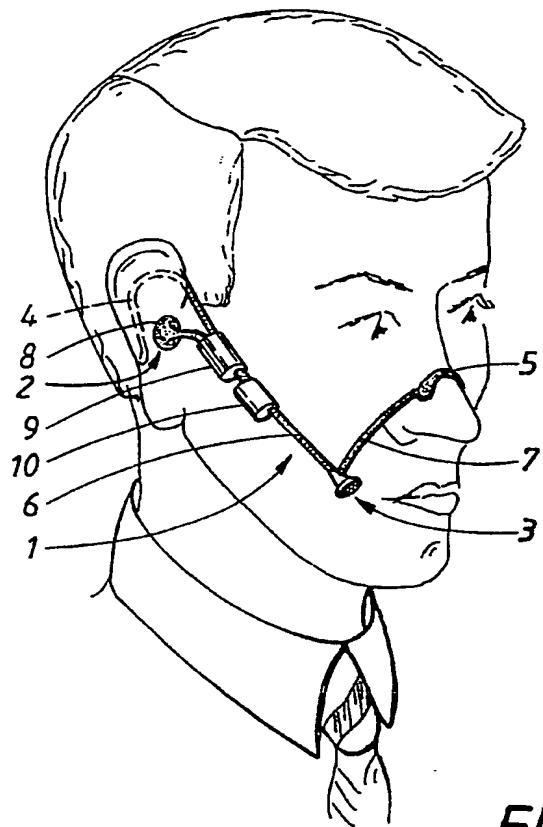


FIG.2

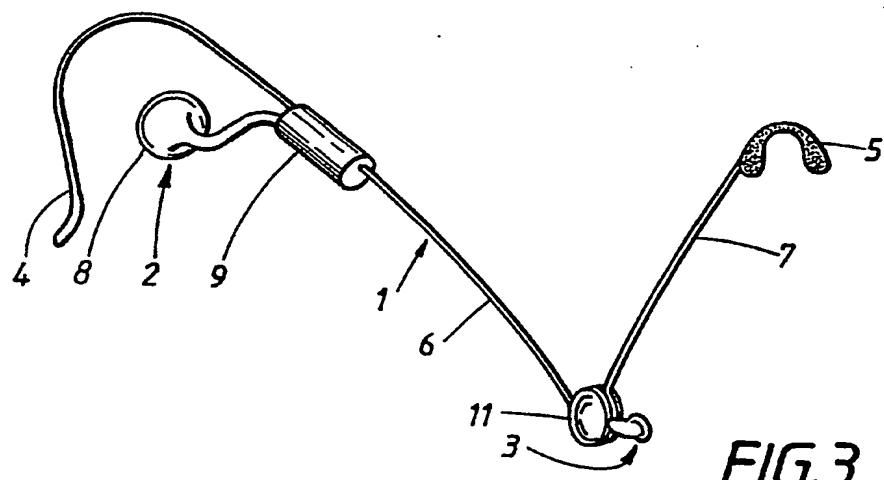


FIG.3

INTERNATIONAL SEARCH REPORT

International Application No. PCT/SE 90/00121

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all)⁶

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: H 04 R 1/08, 1/10; H 04 M 1/05

II. FIELDS SEARCHED

Minimum Documentation Searched⁷

| Classification System | Classification Symbols |
|-----------------------|------------------------|
| IPC5 | H 04 R, H 04 M |

Documentation Searched other than Minimum Documentation
to the Extent that such Documents are Included in Fields Searched⁸

SE,DK,FI,NO classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹

| Category | Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹² | Relevant to Claim No. ¹³ |
|----------|---|-------------------------------------|
| A | US, A, 4179590 (SNOW) 18 December 1979, see figures 1-5 -- | 1-12 |
| A | US, A, 4020297 (BRODIE) 26 April 1977, see the whole document -- | 1-12 |
| A | Patent Abstracts of Japan, Vol 10, No 275, E438, abstract of JP 61- 95696, publ 1986-05-14 HITACHI LTD ----- | 1-12 |

* Special categories of cited documents:¹⁰

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search
21st May 1990

Date of Mailing of this International Search Report
1990 -06- 01

International Searching Authority

SWEDISH PATENT OFFICE

Signature of Authorized Officer

SVEN FENGER-KROG

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.PCT/SE 90/00121**

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the Swedish Patent Office EDP file on **90-05-07**.
The Swedish Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---------------------|----------------------------|---------------------|
| US-A- 4179590 | 79-12-18 | NONE | |
| US-A- 4020297 | 77-04-26 | JP-A- 52088014 | 77-07-22 |

THIS PAGE BLANK (USPTO)